Epilepsy

Epilepsy

- Chronic brain disease characterized by (unprovoked) repetitive epileptic seizures .
- Single epileptic seizure can be provoked also in a healthy human without neurologic disease! (sleep deprivation, abstention syndrome – barbiturates, alcohol, hypoglycemia, extremely strong stimulus…)
- One of the most frequent chronic brain diseases

Etiology of epilepsy

- **Primary**: unknown cause, onset usually in the childhood or adolescence, genetic disposition
- **Secondary** (symptomatic): no genetic disposition, known epileptogenic factors

  - states after stroke, posttraumatic scar, tumors, inflammation, developmental brain disorders...

E.g. in 5-9% of patients after stroke vascular epilepsy develops.

In general: Any affection of neurons can lead to epilepsy.

But: No neurons = No epilepsy

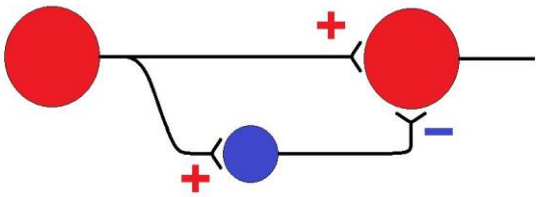
→ Epilepsy does not originate in the center of the scar or postmalatic pseudocyst, but from its margin or surrounding where injured neurons survive.

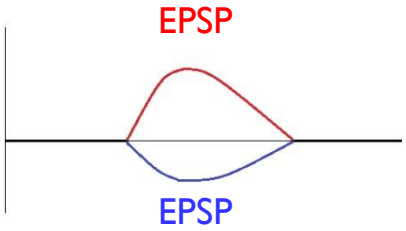
Abnormal epileptiform behavior of neurons of the epileptic focus

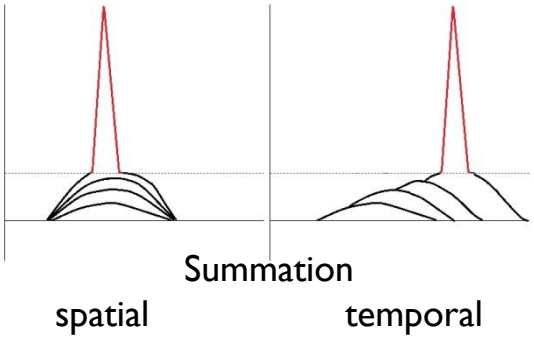
- **Hyperexcitability** – abnormal excessive electric reaction of neurons to a common stimulus
- **Hypersynchrony** – ability of neuronal population of the focus to produce synchronic action potentials
- **Epileptic focus:** any area of the gray matter (neocortex, hippocampus...)

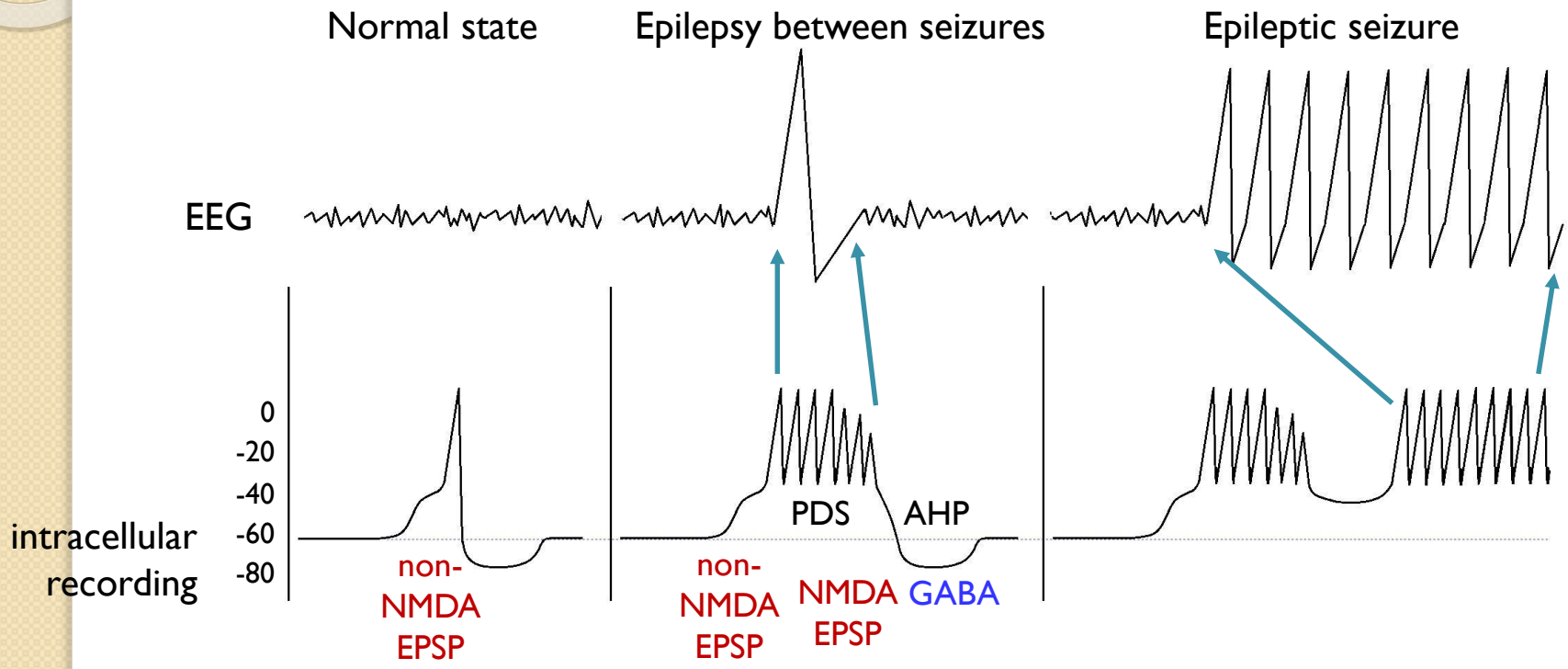
What is the mechanism of epileptiform behavior of neurons?

- **Hyperexcitability of the brain cortex:** failure of labile physiological balance between excitatory glutamatergic and inhibitory GABAergic afferentation of the pyramidal cells
- **Existence of the thalamic pacemaker:** It forces its oscillative electric activity to the pyramidal cells of the cortex (NonREM sleep, absence)
- **Neuromodulatory effect of the brain stem RAS:** NA and serotonergic part of the RAS increases excitability of brain cortex neurons (sleep deprivation!)









PDS = paroxysmal depolarizing shift
AHP = afterhyperpolarization
EPSP = excitatory postsynaptic potential
IPSP = inhibitory postsynaptic potential

Factors determining epileptic seizure rise

- **Epileptic focus**

  - morphologically defined (tumor, scar, malformation...) or undefined

- **Threshold**

  Determined by properties of the focus and recent state (sleep deprivation, glycemia, medicaments, drugs, alcohol...)

- **Stimulus**

  - intensity and character (E.g. repetitive light flashes are dangerous)

Classification of epileptic seizures (topographic point of view)

- **Partial seizures**: abnormal electric behavior of neurons in a restricted cortical area of one brain hemisphere

  <u>According to consciousness alteration</u>: simplex partial seizures x complex partial seizures (qualitative disorders of consciousness)

- **Generalized seizures**: abnormal electric activity affects cortical neurons of both brain hemispheres in a diffuse way (primary x secondary, convulsive x nonconvulsive)

Partial seizures

- epileptic focus in a restricted area of the brain cortex
- **simplex**: without changes of consciousness (g. praecentralis → muscle contractions on contralateral side of the body, g. postcentralis → paresthesia on contralateral side of the body), Jackson's epilepsy
- **complex**: with deterioration of cognitive functions, often the frontal and temporal lobe, psychomotor seizure: running, senseless activity, changes of affects, instincts (amygdale, hippocampus)

Generalized seizures

- **Primary** (the epileptic focus is the whole brain cortex from the beginning of the seizure) x **secondarily** generalized

Absence (petit mal), 5-15s many times per day

In children up to 10 years of age

The child looks stiff in front of itself and does not respond.

EEG: spike oscillations with a frequency of 3Hz

Tonic-clonic seizure (grand mal), 1-5min

Cramps, loss of consciousness, tongue biting, incontinency

After the seizure: confusion, aggressivity, amnesia

EEG: sharp waves with high amplitude, up to 100Hz

Complications: status epilepticus – glutamate excitotoxicity!

Examination in interictal period

- Abnormal electric activity of the neurons can persist during the subclinic period.
- Examination after sleep deprivation, hyperventilation, photostimulation…
- Detection of the epileptic focus: EEG registration of epileptiform patterns (abnormalities):

  - spike – 20-70 ms, sharp wave – 70-200 ms

  - marked in the background EEG activity (focal x generalized)